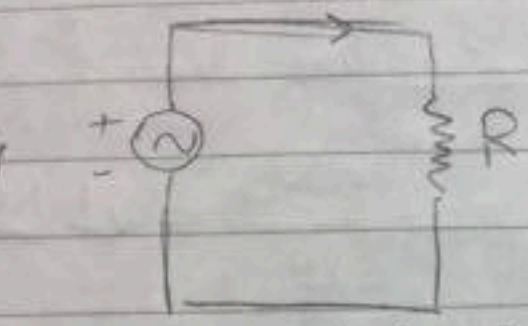
Subject. Date.

Response of Basic elements to sinusoidal wave:

① R



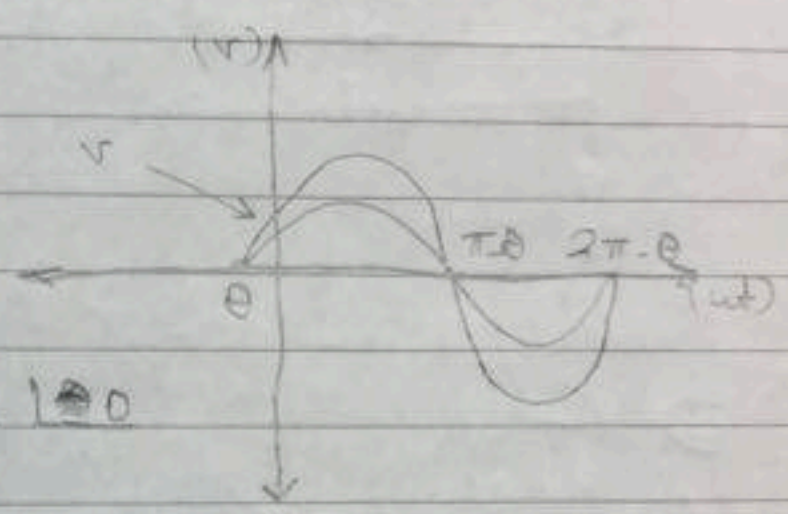
$$i = \frac{v}{R} = \frac{V_m}{R}\sin(\omega t + \theta)$$

$$= I_m \sin(\omega t + \theta)$$

$$v = V_m \sin(\omega t + \theta)$$

$$\vec{V} = V \angle\theta$$

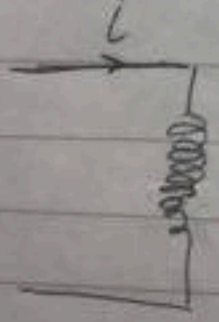
$$R = \frac{\vec{V}}{\vec{I}} = \frac{V\angle\theta}{I\angle\theta} = \frac{V}{I}\angle 0$$



Power factor $\triangleq \cos(\theta_v - \theta_i) = \cos\theta$

pf = 1 unity PF

② L



$$v = L\frac{di}{dt} = L\frac{d}{dt}(I_m \sin\omega t)$$

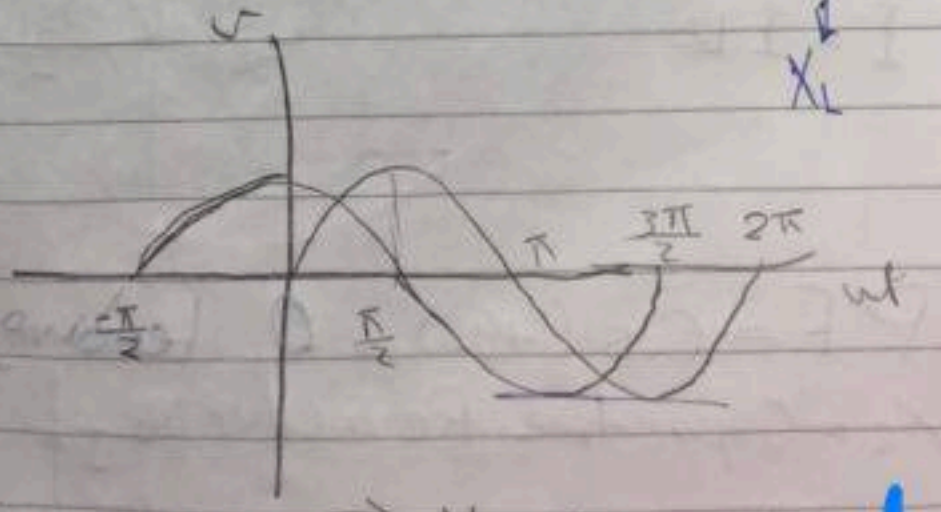
$$v = I_m \cdot \omega \cdot L \cos\omega t = I_m (\omega L)\sin(\omega t + 90)$$

$$X_L$$

$$i = I_m \sin(\omega t)$$

$$I = \frac{I_m}{\sqrt{2}}\angle 0$$

$$\omega L = X_L$$



$$v = V_m \sin(\omega t + 90) \rightarrow \vec{V} = \frac{V_m}{\sqrt{2}}\angle 90$$

$I_m X_L$

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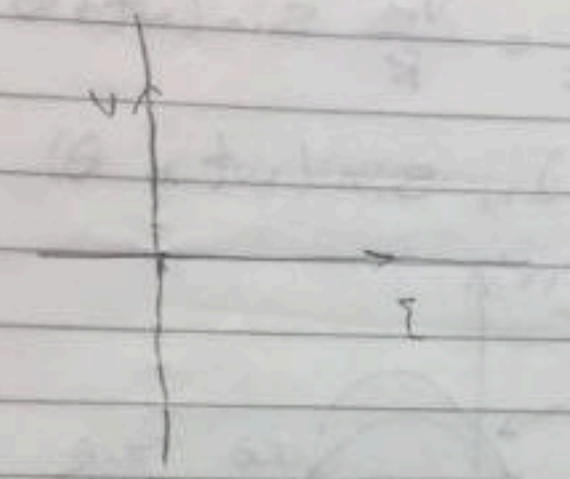
$v = V_m \sin(\omega t + 90) \rightarrow \vec{V} = \frac{V_m}{\sqrt{2}} \angle 90$

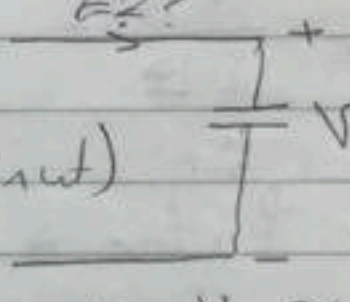
$PF = \cos(90) = 0$ Lag



$X_L \triangleq$ Inductive Reactance

$X_L = \frac{\vec{V}}{\vec{I}} = \frac{V \angle 90}{I \angle 0} = \omega L \angle 90$

③ C



$i = C \frac{dv}{dt} = C \frac{d}{dt}(V_m \sin \omega t)$

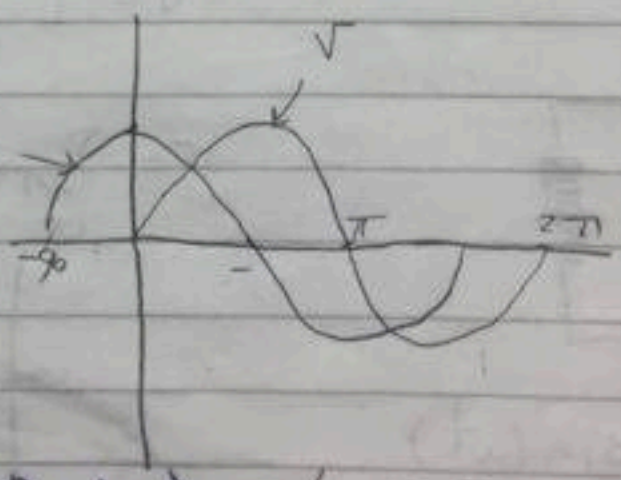
$v = V_m \sin \omega t$

$= C V_m \omega \cos \omega t$

$= \omega C V_m \sin(\omega t + 90)$

$I_m \sin(\omega t + 90)$

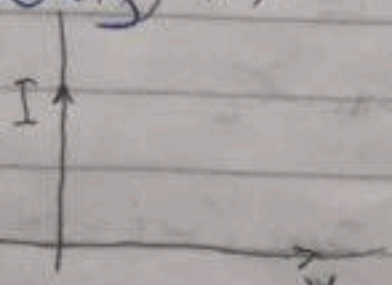
$\vec{I} = I \angle 90$



$PF = \cos(+90) = 0$ leading PF

$X_C =$ Capactive Reactance

$X_C = \frac{\vec{V}}{\vec{I}} = \frac{V \angle 0}{\omega C V_m \angle 90} = \frac{1}{\omega L \angle 90}$



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$$X_C = \frac{1}{wC} \angle -90 = \frac{-I}{wC} = \frac{1}{\hat{j}\,wC}$$

$$X_L = wL \angle 90^\circ = \hat{j}\,wL$$

Respond of Basic elements to sinusoital wave:

① $v = 10\sin(\omega t + 30)$, $i = 25\sin(\omega t + 30)$

② $v = 100\sin(314t + 30)$, $i = 10\sin(314t + 60)$

③ $v = 100\sin(314t + 30)$, $i = 10\sin(314t + 120)$

④ $v = 100\sin(314t$, $i = 20\cos(314t)$ بزاحت بترد

① $R = \frac{V_m}{I_m} = 5\,\Omega$

② v lead i by 90°

∴ element is L

L = ?

$$X_L = \frac{V_m}{I_m} = \frac{10\angle}{10\angle} = 10$$

$$X_L = \frac{V_m \angle\theta_v}{V_i \angle\theta_i} = \frac{100\angle 30}{10\angle -60} = 10\angle 90 = \hat{j}\,10 = wL$$

$wL = 314$

③ Since i lead v by 90°

∴ C

$$X_C = \frac{\vec{V}}{\vec{I}} = \frac{\frac{100}{\sqrt{2}}\angle 30}{\frac{10}{\sqrt{2}}\angle 120} = 10\angle -90 = \frac{1}{wC}\angle -90$$

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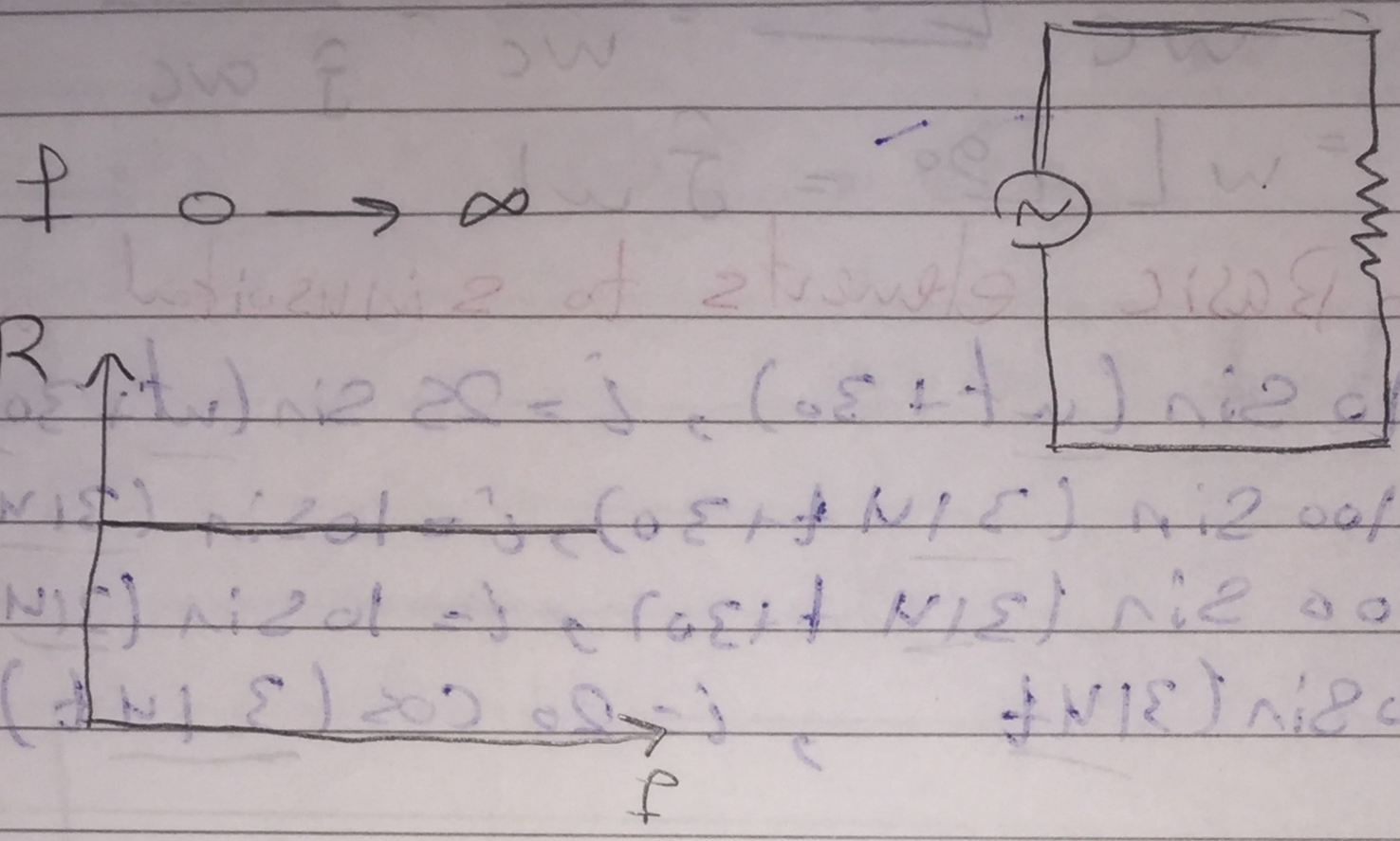
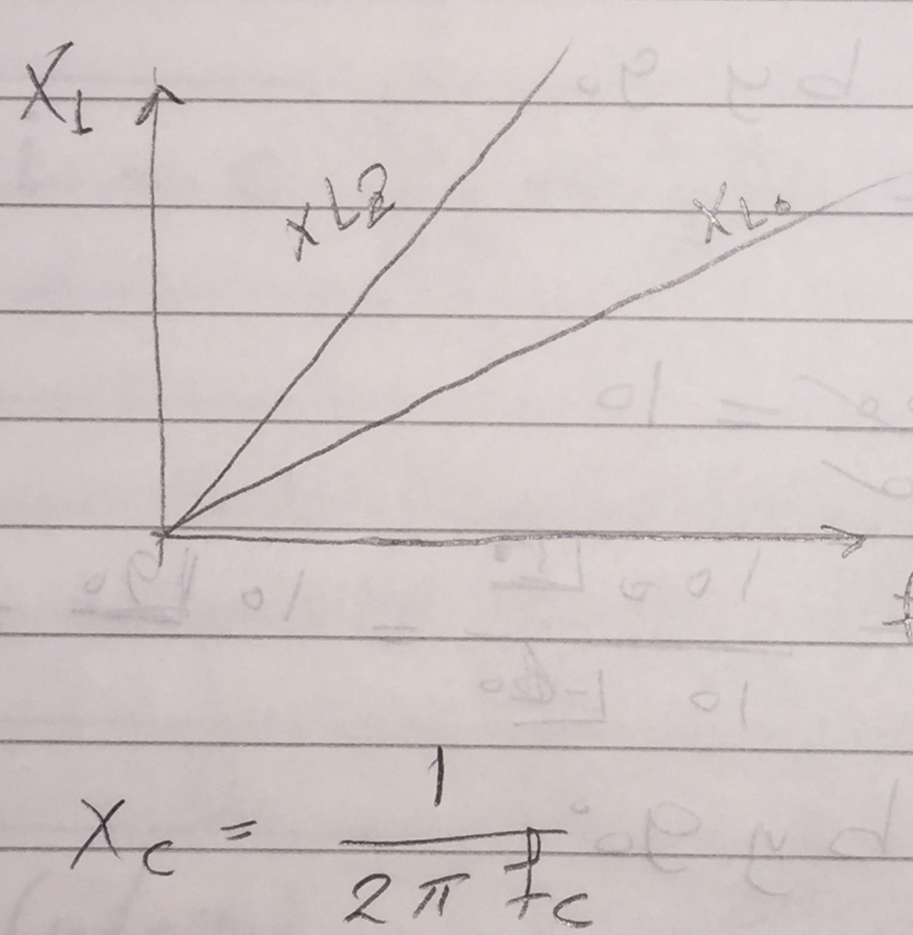
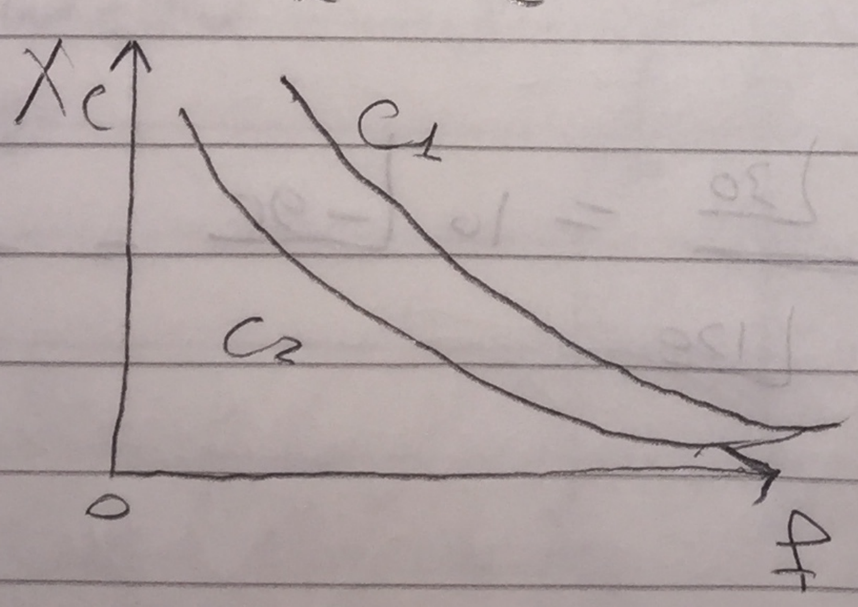
. Frequency Response of R, L . C



$$X_L = wL = 2\pi f L$$



$$X_C = \frac{1}{2\pi f C}$$